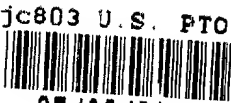


IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Assistant Commissioner for Patents
Washington, D.C. 20231

Atty. Dkt.: 2992-12

Sir:



Date: July 20, 2000

Attached for filing is the patent application of:

Inventor: IYER

Entitled: **BEAM FILLED WITH MATERIAL, DECK
SYSTEM AND METHOD**

and including attachments as noted below:

- ☒ Declaration, ☒ Abstract
14 pages of specification and claims (including 21 numbered claims), and
1 sheets of accompanying drawing/s.
☒ Record & return the attached assignment to the undersigned.
☐ Priority is hereby claimed under 35 USC 119 based on the following foreign applications, the entire content of which is hereby incorporated by reference in this application:

Application Number	Country	Day/Month/Year Filed
--------------------	---------	----------------------

- ☐ , respectively.
☐ Certified copy(ies) of foreign application(s) is/are attached.
☐ Please amend the specification by inserting before the first line --This is a _____ of PCT application _____, filed _____, the entire content of which is hereby incorporated by reference in this application.--
☐ Priority is hereby claimed under 35 USC 120/365 based on the following prior PCT applications designating the U.S., the entire content of which is hereby incorporated by reference in this application:

Application Number	Country	Day/Month/Year Filed
--------------------	---------	----------------------

- ☒ This application is based on the following prior provisional application(s):

Application No.	Filing Date
60/145,954	July 28, 1999

respectively, the entire content of which is hereby incorporated by reference in this application, and priority is hereby claimed therefrom.

- ☐ Please amend the specification by inserting before the first line: -- This application claims the benefit of U.S. Provisional Application No. _____, filed _____, the entire content of which is hereby incorporated by reference in this application.

- ☒ Two (2) Verified Statements attached establishing "small entity" status (Rules 9 & 27)

- ☐ The Examiner's attention is directed to the prior art cited in the parent application by applicant and/or Examiner for the reasons stated therein.

- ☐ Preliminary amendment to claims (attached hereto), to be entered before calculation of the fee below.

- ☒ Also attached: **Exclusive Substitute Power of Attorney by Assignee with copy of Assignment attached**

FILING FEE IS BASED ON CLAIMS AS FILED LESS ANY HEREWITH CANCELED

Basic Filing Fee		\$	690.00
Total effective claims	21 - 20 (at least 20) = 1	x \$ 18.00	\$ 18.00
Independent claims	4 - 3 (at least 3) = 1	x \$ 78.00	\$ 78.00
If any proper multiple dependent claims now added for first time, add \$260.00 (ignore improper)			\$ 0.00
		SUBTOTAL	\$ 786.00
If "small entity," then enter half (1/2) of subtotal and subtract		-\$	393.00)
		SECOND SUBTOTAL	\$ 393.00
Assignment Recording Fee (\$40.00)		\$	40.00
		TOTAL FEE ENCLOSED	\$ 433.00

Any future submission requiring an extension of time is hereby stated to include a petition for such time extension.

The Commissioner is hereby authorized to charge any deficiency in the fee(s) filed, or asserted to be filed, or which should have been filed herewith (or with any paper hereafter filed in this application by this firm) to our **Account No. 14-1140**. A duplicate copy of this sheet is attached.

1100 North Glebe Road, 8th Floor
Arlington, Virginia 22201-4714
Telephone: (703) 816-4000
Facsimile: (703) 816-4100
AMK:jls

NIXON & VANDERHYTE P.C.

By Atty: Alan M. Kagen, Reg. No. 36,178

Signature: _____

Applicant or Patentee: IYER Attorney's Dkt. No. 2992-12
Serial or Patent No.: To Be Assigned
Filed or Issued: Concurrently Herewith
For: BEAM FILLED WITH MATERIAL, DECK SYSTEM AND METHOD

**VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY
STATUS [37 19(f) and 1.27(e)] - INDEPENDENT INVENTOR**

As a below named inventor, I hereby declare that I qualify as an independent inventor as defined in 37 CFR 1.9(c) for purposes of paying reduced fees under Section 41 (a) and (b) of Title 35, United States Code, to the Patent and Trademark Office with regard to the invention entitled:

BEAM FILLED WITH MATERIAL, DECK SYSTEM AND METHOD

described in

☒ the specification filed herewith.
☐ application Serial No. To Be Assigned, filed Concurrently Herewith
☐ patent No. _____, issued _____

I have not assigned, granted, conveyed or licensed and am under no obligation under contract or law to assign, grant, convey or license, any rights in the invention to any person who could not be classified as an independent inventor under 37 CFR 1.9(c) if that person had made the invention, or to any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern or organization to which I have assigned, granted, conveyed, or licensed or am under an obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below:

☐ no such person, concern, or organization
☒ persons, concerns or organizations listed below*

NOTE: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27)


Name South Dakota School of Mines and Technology
Address 501 East Saint Joseph Street, Rapid City, South Dakota 57701-3995
☐ Individual ☐ Small Business Concern ☒ Nonprofit Organization

Name _____
Address _____
☐ Individual ☐ Small Business Concern ☐ Nonprofit Organization

Name _____
Address _____
☐ Individual ☐ Small Business Concern ☐ Nonprofit Organization

I acknowledge the duty to file, in this application of patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. [37 CFR 1.28(b)]

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under § 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

NAME OF INVENTOR	NAME OF INVENTOR	NAME OF INVENTOR
<u>Srinivasa L. Iyer</u>		
		
Signature	Signature	Signature
<u>7-12-2000</u>		
DATE	DATE	DATE

OMB NO. 0651-0011 (12/3/86)

Applicant or Patentee: IYER Attorney's
Serial or Patent No.: To Be Assigned Dkt. No.: 2992-12
Filed or Issued: Concurrently Herewith
For: BEAM FILLED WITH MATERIAL, DECK SYSTEM AND METHOD

VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY
STATUS (37 1.9(f) and 1.27 (c)) - **NONPROFIT ORGANIZATION**

I hereby declare that I am an official empowered to act on behalf of the nonprofit organization identified below:

NAME OF ORGANIZATION South Dakota School of Mines and Technology
ADDRESS OF ORGANIZATION 501 East Saint Joseph Street, Rapid City, South Dakota 57701-3995

TYPE OF NONPROFIT ORGANIZATION

- ☒ University or other institution of higher education
☐ Tax exempt under Internal Revenue Service Code (26 U.S.C. 501(a) and 501(c)(3))
☐ Nonprofit scientific or educational under statute of state of The United States of America
(Name of state _____)
(Citation of statute _____)
☐ Would qualify as tax exempt under Internal Revenue Service Code (26 U.S.C. 501(a) and 501(c)(3)) if located in the United States
☐ Would qualify as nonprofit scientific or educational under statute of state of The United States of America if located in The United States of America
(Name of state _____)
(Citation of statute _____)

I hereby declare that the nonprofit organization identified above qualifies as a nonprofit organization as defined in 37 CFR 1.9 (3) for purposes of paying reduced fees to the United States Patent and Trademark Office regarding the invention described in:

- ☒ the specification filed herewith with title as listed above.
☐ application identified above.
☐ the patent identified above.

I hereby declare that rights under contract or law have been conveyed to and remain with the nonprofit organization with regard to the above identified invention. If the rights held by the nonprofit organization are not exclusive, each individual, concern or organization having rights to the invention is listed below* and no rights to the invention are held by any person, other than the inventor, who could not qualify as an independent inventor under 37 CFR 1.9(c) if that person made the invention, or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern or organization having any rights in the invention is listed below:

- ☒ no such person, concern, or organization exists.
☐ each such person, concern or organization is listed below.*

Separate verified statement is requested from each person, concern or organization named immediately above having rights to the invention, averring to his/her/its status as a small entity. (37 CFR 1.27)

I acknowledge the duty to file, in this application of patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

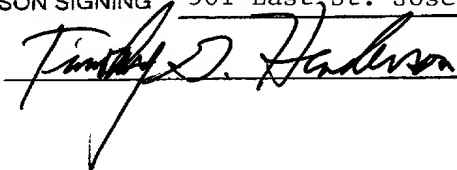
I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

NAME OF PERSON SIGNING Timothy G. Henderson

TITLE IN ORGANIZATION South Dakota School of Mines and Technology

ADDRESS PERSON SIGNING 501 East St. Joseph Street

SIGNATURE



DATE

7/15/00

BEAM FILLED WITH MATERIAL, DECK SYSTEM AND METHOD

This application claims the benefit of U.S. Provisional Patent Application Serial No. 60/145,954, filed July 28, 1999, the entire
5 content of which is herein incorporated by reference.

BACKGROUND AND SUMMARY OF INVENTION

The present invention relates to beam construction and, more particularly, to a beam constructed of a tubular housing filled with a filler material such as concrete, a deck system using such beams, and
10 a method of manufacturing the beams.

Timber-plank bridge decks are a popular type of bridge deck used in the Northeast and Northwest areas of the United States. By placing 2x10 or 2x12 joists side-by-side and introducing post-tensioning strands through the joists in the transverse direction, an
15 economical bridge deck system can be built relatively quickly and easily. The problem with this type of bridge arises from the wood. The wood can exhibit substantial creep properties resulting in the continual loss of post-tensioning stress. In addition, when subjected to a moist climate, the wood can begin to rot, thus resulting in its
20 required replacement.

The discovery of new construction materials for this type of civil engineering application has thus become an increasingly popular engagement. Materials such as fiberglass reinforced plastics (FRP)

are strong, non-corrosive, and attractive. Fiberglass has a high strength-to-weight ratio and can be easily manufactured for many different types of applications. An FRP section alone will not work, however, because the modulus of an FRP section is insufficient to provide the required stiffness for construction applications such as a deck, and prestressing in the transverse direction is not possible as the wall thickness of the web is not strong enough to take the anticipated load. To strengthen the beam, fiberglass tubes can be filled with concrete, the most popular and economical construction material in the world, to form a solid beam capable of withstanding significant loads. With the introduction of prestressing to the concrete within the tubes, deflection and cracking of the concrete can be controlled. These filled tubes can be placed side-by-side, similar to the wood joists, and post-tensioned transversely for use in a bridge deck system or the like.

This invention addresses filling the tubes with concrete to increase the moment of inertia of the sections and addresses prestressing the stiffness for the sections. By filling the tube with concrete, the transverse prestressing force in the deck construction can be increased to provide a higher distribution width for the bridge deck compared to a wood deck system. This in turn yields a better, more efficient and cost effective deck system for bridges to meet stiffness and strength requirements.

The tube confines the concrete inside the tube due to the prestressing in the longitudinal direction, which creates an expansion

of concrete in the lateral direction (Poisson's ratio effect) that is prevented by the tube, which has a Poisson's ratio less than that of the concrete. This confinement increases the strength of the concrete inside the tube to make this system much more attractive for

5 structural applications such as bridges.

The system does not require the costly formwork for concrete decks, or curing of concrete. No steel reinforcements that develop corrosion are included, and hence, the beams are very durable compared to wood or reinforced concrete. The beams can be used for
10 any construction previously using wood beams, concrete beams and even steel beams, such as temporary structures, scaffolding platforms and building floors where stiffness requirements may or may not be critical.

Internal and external spiral reinforcements in concrete provide
15 varying degrees of confinement to concrete. Steel tubes/spiral reinforcements are used in concrete, but seldom achieve very high confinement. Using an FRP material (with proper Poisson's ratio) or like material provides very high confinement to increase the compressive (up to 10 times) and shear strength of confined concrete.
20 An important consideration is to keep the Poisson's ratio of the tube less than concrete to provide the confinement to concrete. This increased strength depends on the fiber architecture and the thickness of the tube.

In accordance with an exemplary embodiment of the invention,
25 a construction beam includes a tubular housing filled with a solid

material, wherein a Poisson's ratio of the tubular housing is less than the solid material to thereby confine the solid material. The construction beam may further include at least one reinforcing rod in the tubular housing such that the solid material surrounds the

5 reinforcing rod. Preferably, the reinforcing rod is prestressed in the tubular housing. In one embodiment, the solid material is concrete, which is formed in the tubular housing after placing the reinforcing rod. The housing itself is preferably formed of a fiber-reinforced polymer such as fiberglass, carbon, Kevlar and the like. The solid
10 material may be one of concrete, fiber-reinforced concrete, polymer concrete, sand, structural foam and the like. Additionally, the reinforcing rod may be formed of steel, carbon, fiberglass, Kevlar and the like. The tubular housing generally may be formed with any geometrically-shaped cross section.

15 In accordance with another exemplary embodiment of the invention, a deck system includes a plurality of the construction beams of the invention secured side-to-side. In this context, each of the construction beams may further include at least one transverse aperture therein defining a corresponding at least one transverse
20 channel. At least one reinforcing bar may be extended through the transverse channel. In one embodiment, the reinforcing bar extending through the transverse channel is secured under tension to provide a transverse post-stress in the deck system.

In accordance with still another embodiment of the invention, a
25 method of forming a construction beam includes the step of filling a

tubular housing with a solid material, wherein a Poisson's ratio of the tubular housing is less than the solid material to thereby confine the solid material.

BRIEF DESCRIPTION OF THE DRAWINGS

5 These and other aspects and advantages of the present invention will be described in detail with reference to the accompanying drawings, in which:

FIGURE 1 is a perspective view of an exemplary construction beam according to the present invention; and

10 FIGURE 2 is a plan view of a deck system constructed using construction beams according to the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to FIGURE 1, a construction beam 10 is formed of a tubular housing 12 filled with a solid material 14. As shown, the beam 10 is formed in a generally square or rectangular shape, however, any geometric shape such as triangle, circle, hexagon, etc. could be formed. The material of the tubular housing 12 is preferably a fiber-reinforced polymer (FRP) such as fiberglass, carbon, Kevlar or the like. The solid filler material 14 can be any material that resists high compressive strength in a confined environment. Preferably, the filler material 14 is concrete, fiber-reinforced concrete, polymer concrete, sand, structural foam or the like.

Using a fiber-reinforced polymer or like material for the tubular housing 12 provides a very high confinement to increase the compressive and shear strength of the confined filler material 14. To provide the confinement of the filler material 14, the Poisson's ratio of the tubular housing 12 is kept less than the filler material 14, which is particularly important for lateral confinement by the tube in the absence of prestressing. This increased strength depends on the fiber architecture and the thickness of the tube 12. The fiber architecture is the direction of fiber and amount of fiber used to make the tube. This architecture influences properties of the tube such as Poisson's ratio, modulus of elasticity and strength of the tube.

With continued reference to Figure 1, one or more reinforcing members 16 are embedded in the filler material 14. The reinforcing rods or cables 16 can be formed of steel, carbon, fiberglass, Kevlar or any fiber-reinforced polymer material, or the like. In order to increase the tensile capacity of the filler material, the reinforcing rods or cables 16 are placed under tension prior to filling the tubular housing 12 with the filler material 14. This tensioning or stressing using a pretension method, so-called "prestressing," of the beam 10 helps to control cracking of the concrete and allows for an increased moment of inertia and stiffness. The increase in moment of inertia and increase in stiffness cause less overall deflection. The prestressing also causes the concrete to bond with the tube due to the slight expansion of the concrete due to the prestress force.

In an exemplary construction beam, the reinforcing rods or cables 16 are inserted in the tubular housing 12 and secured in position by plates or the like with holes therein. After each plate is properly positioned, a chuck is placed on each cable 16 and the cable is secured by hand. A hydraulic jack can then be placed on the cable, and the cables are placed under tension. With normal prestressing with steel cables, prestressing values range from 60-70% of the ultimate strength of steel cables, which is controlled by the American Concrete Institute - Code for Prestressing Concrete with Steel Cables. Similar conditions are available for other cables using fiber-reinforced polymer materials.

The tubular housing 12 is then filled with the filler material 14 such as concrete. Placement of the concrete can be done using a grout pump that delivers the concrete through a fixed diameter hose such as a four-inch diameter hose. The concrete is consolidated by tapping the housing 12 with a rubber mallet and using a two-inch diameter, eight foot long vibrating apparatus. The frames are preferably secured to ensure that the prestressing cables 16 are centered. The top and bottom of the tubular housing 12 should be tied to the prestressing frame to prevent movement of the tube during concrete placement.

The concrete is then allowed to cure until a desired compressive strength is achieved. Subsequently, the pre-tensioning of the cables or rods 16 is released by cutting the cables 16 using an acetylene torch or the like.

Prior to prestressing the beam 10 and filling with the filler material 14, a plurality of transverse apertures 18 are formed through the tubular housing 12. The apertures 18, aligned with corresponding apertures in adjacent beams 10, define a transverse channel for receiving a post-stressing reinforcing member 20. (See FIGURE 2). During the beam forming operation, the transverse apertures 18 are blocked to prevent concrete from filling the spaces using, for example, electrical conduit, wood dowels, foams or the like. In the case of wood dowels, for example, once the filler material 14 is set or cured, the dowels can be drilled out to re-open the apertures 18.

In an alternative construction, the reinforcing cables or rods 16 may be subjected to stress using a post-tension method or "post-stressing" as opposed to prestressing with similar benefits. In this context, an aperture or channel can be formed along a longitudinal axis of the beam for receiving the reinforcing cables or rods 16 after insertion of the filler material 14. Once inserted, the rods 16 are placed under tension and secured.

Referring to FIGURE 2, the construction of a deck system 22 using the construction beam 10 according to the invention will be described. A plurality of beams 10 are aligned such that the transverse apertures 18 of each beam are aligned with apertures of an adjacent beam to define a transverse channel 24. The reinforcing rods or bars 20 are inserted through each of the transverse channels 24 and secured to steel plates or the like for post-tensioning. The steel base plates serve to improve the distribution of the post-tensioning force on

the deck 22. A hydraulic jack or the like is then secured to the transverse reinforcing bars 20, and the bars 20 are placed under tension. Stressing of the reinforcing rods 20 can be performed at once or one at a time. Once stressed, the rods 20 are secured using a nut or
5 chuck or the like, and the hydraulic jack is released.

The concrete filled construction beam with or without prestressing has a low modulus and hence is controlled by deflection requirements. The deflection requirements can be addressed by increasing the moment of inertia of the section, which will in turn
10 increase the cross section and self-weight of the structure and also will increase the prestressing force required for the structure. With the structure according to the present invention, the moment of inertia of the construction beam can be increased without increasing the cross sectional area of the section. This also increases the
15 confinement of the filled material in case of large sections. A confined concrete, for example, can develop a strength that is ten times that of ordinary concrete, and by prestressing, the section can easily take 20,000 psi or more in tension and compression and it can compete with structural steel, while being very economical to use
20 over conventional reinforced concrete or steel. At the same time, the FRP tubular construction beam will not corrode, rot, shrink or expand due to moisture conditions. If the filler material such as concrete is cracked, the fiber-reinforced polymer tubular housing is strong in tension and thereby will carry the load. The high strength-to-weight

ratio of the preferred materials keeps the construction beam relatively light with very high strength characteristics.

While the invention has been described in connection with what is presently considered to be the most practical and preferred
5 embodiments, it is to be understood that the invention is not to be limited to the disclosed embodiments, but on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

WHAT IS CLAIMED IS:

1. A construction beam comprising a tubular housing filled with a solid material, wherein a Poisson's ratio of the tubular housing is less than the solid material to thereby confine the solid material.

2. A construction beam according to claim 1, further comprising at least one reinforcing rod in the tubular housing such that the solid material surrounds the reinforcing rod.

3. A construction beam according to claim 2, wherein the at least one reinforcing rod is stressed using a pretension method in the tubular housing.

4. A construction beam according to claim 2, wherein the at least one reinforcing rod stressed using a post-tension method in the tubular housing.

5. A construction beam according to claim 1, wherein the solid material is concrete, and wherein the construction beam further comprises at least one reinforcing rod in the tubular housing, the concrete being formed in the tubular housing after placing the reinforcing rod.

6. A construction beam according to claim 5, wherein the at least one reinforcing rod is prestressed prior to forming the concrete in the tubular housing.

7. A construction beam according to claim 1, wherein the tubular housing is formed of a fiber reinforced polymer.

8. A construction beam according to claim 7, wherein the solid material is concrete.

9. A construction beam according to claim 8, further comprising at least one reinforcing rod in the tubular housing.

10. A construction beam according to claim 9, wherein the reinforcing rod is formed of a material selected from the group comprising steel, carbon, fiberglass, and Kevlar.

11. A construction beam according to claim 7, wherein the solid material is a material selected from the group comprising concrete, fiber reinforced concrete, polymer concrete, sand, and structural foam.

12. A construction beam according to claim 7, wherein the tubular housing is formed of a material selected from the group comprising fiberglass, carbon, and Kevlar.

13. A construction beam according to claim 1, wherein the tubular housing comprises a geometrically-shaped cross-section.

14. A deck system comprising a plurality of construction beams secured side-to-side, wherein each of the construction beams comprises a tubular housing filled with a solid material, wherein a

Poisson's ratio of the tubular housing is less than the solid material to thereby confine the solid material.

15. A deck system according to claim 14, wherein each of the construction beams further comprises at least one transverse aperture therein defining a corresponding at least one transverse channel, the deck system further comprising at least one reinforcing bar extending through the transverse channel.

16. A deck system according to claim 15, wherein the at least one reinforcing bar is secured in the transverse channel under tension to provide a transverse post-stress in the deck system.

17. A method of forming a construction beam comprising filling a tubular housing with a solid material, wherein a Poisson's ratio of the tubular housing is less than the solid material to thereby confine the solid material.

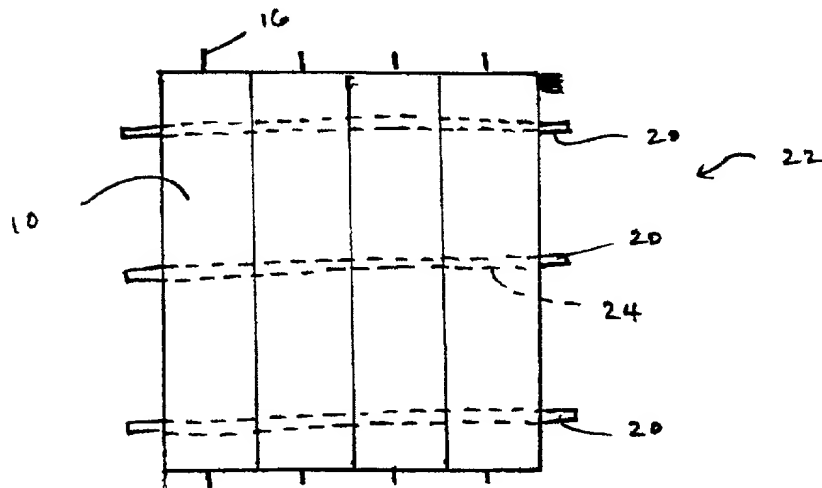
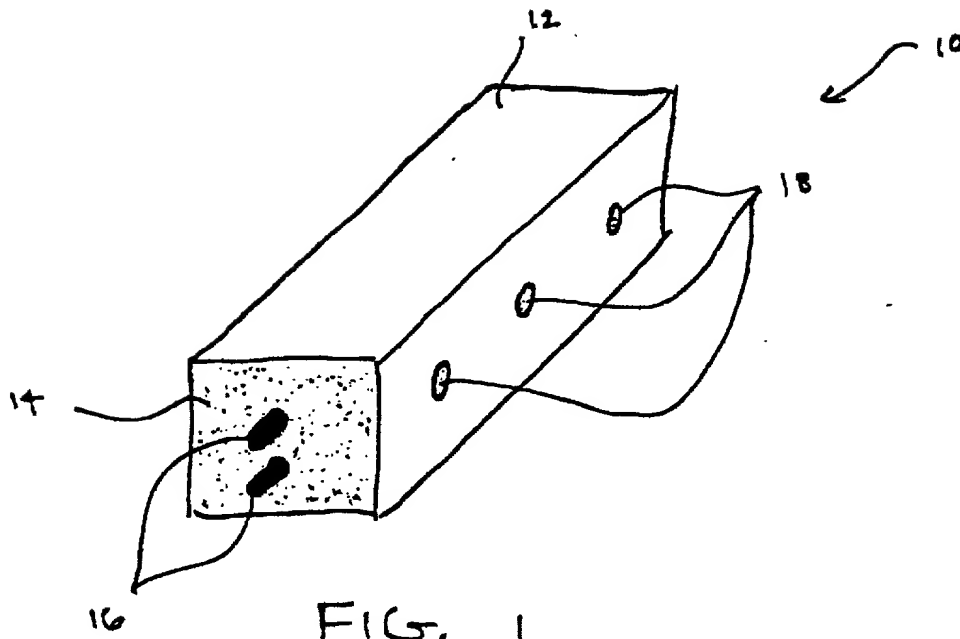
18. A method according to claim 17, further comprising securing at least one reinforcing rod in the tubular housing such that the solid material surrounds the reinforcing rod.

19. A method according to claim 18, wherein the securing step comprises placing the at least one reinforcing rod under tension prior to filling the tubular housing with the solid material such that the reinforcing rod is prestressed in the tubular housing.

**BEAM FILLED WITH MATERIAL, DECK
SYSTEM AND METHOD**

ABSTRACT OF THE DISCLOSURE

A construction beam includes a tubular housing preferably
5 formed of a fiber-reinforced polymer filled with a solid filler material
such as concrete. The Poisson's ratio of the tubular housing is less
than the filler material to provide confinement of the filler material.
One or more reinforcing rods or cables may be embedded in the filler
material and prestressed prior to setting the filler material to control
10 cracking of the filler material and to allow for an increased moment of
inertia and stiffness. The resulting construction is particularly strong,
lightweight and essentially impervious to environmental conditions.



2992-12

Nixon & Vanderhye P.C. (10/99)
(Domestic Assigned) Page 1

RULE 63 (37 C.F.R. 1.63)
INVENTORS DECLARATION FOR PATENT APPLICATION
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

As a below named inventor, I hereby declare that my residence, post office address and citizenship are as stated below next to my name, and I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

BEAM FILLED WITH MATERIAL, DECK SYSTEM AND METHOD

the specification of which (check applicable box(es)):

☒ is attached hereto
☐ was filed on _____ as U.S. Application Serial No. _____ (Atty. Dkt. No. 2992-12)
☐ was filed as PCT International application No. _____ on _____
and (if applicable to U.S. or PCT application) was amended on _____

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose information which is material to the patentability of this application in accordance with 37 C.F.R. 1.56. I hereby claim foreign priority benefits under 35 U.S.C. 119/365 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed or, if no priority is claimed, before the filing date of this application:

Priority Foreign Application(s):

Application Number	Country	Day/Month/Year Filed
--------------------	---------	----------------------

I hereby claim the benefit under 35 U.S.C. §119(e) of any United States provisional application(s) listed below.

Application Number	Date/Month/Year Filed
60/145,954	28 July 1999

I hereby claim the benefit under 35 U.S.C. 120/365 of all prior United States and PCT international applications listed above or below and, insofar as the subject matter of each of the claims of this application is not disclosed in such prior applications in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose material information as defined in 37 C.F.R. 1.56 which occurred between the filing date of the prior applications and the national or PCT international filing date of this application:

Prior U.S./PCT Application(s):

Application Serial No.	Day/Month/Year Filed	Status: patented pending, abandoned
------------------------	----------------------	--

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon. And on behalf of the owner(s) hereof, I hereby ask that all communications in this matter be directed to: NIXON & VANDERHYE P.C., 1100 North Glebe Rd., 8th Floor, Arlington, VA 22201-4714, telephone number (703) 816-4000.

1. Inventor's Signature: [Signature] Date: 7-8-99
Inventor: Srinivasa L Iyer United States
(first) (last) (citizenship)
Residence: (city) Rapid City (state/country) South Dakota
Post Office Address: 3922 Mountain Shadow Place, Rapid City, South Dakota
(Zip Code) 57702

2. Inventor's Signature: _____ Date: _____
Inventor: _____
(first) MI (last) (citizenship)
Residence: (city) _____ (state/country) _____
Post Office Address: _____
(Zip Code) _____

FOR ADDITIONAL INVENTORS, check box ☐ and attach sheet with same information and signature and date for each.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of

IYER

Atty. Ref.: 2992-12

Serial No. To Be Assigned

Group:

Filed: Concurrently Herewith

Examiner:

For: BEAM FILLED WITH MATERIAL, DECK SYSTEM
AND METHOD

* * * * *

Assistant Commissioner for Patents
Washington, DC 20231

Sir:

**EXCLUSIVE SUBSTITUTE POWER OF ATTORNEY
AND EXCLUSIVE PROSECUTION HEREAFTER BY
ASSIGNEE UNDER 37 C.F.R. §§ 1.36, 3.71 AND 3.73**

The undersigned being the owner of all right, title and interest in the above-identified patent application, hereby revokes all previous powers of attorney in this case, if any, and hereby appoints Nixon & Vanderhye, P.C., 1100 North Glebe Rd., 8th Floor, Arlington, Virginia 22201-4714, telephone number (703) 816-4000, facsimile number (703) 816-4100, and the following attorneys thereof (of the same address) individually and collectively its attorneys to prosecute this application and to transact all business in the Patent and Trademark Office in connection therewith, and with the resulting patent: Arthur R. Crawford, 25327; Larry S. Nixon, 25640; Robert A. Vanderhye, 27076; James T. Hosmer, 30184; Robert W. Faris, 31352; Richard G. Besha, 22770; Mark E. Nusbaum, 32348; Michael J. Keenan, 32106; Bryan H. Davidson, 30251; Stanley C. Spooner, 27393; Leonard C. Mitchard, 29009; Duane M. Byers, 33363; Jeffry

IYER

Serial No. To Be Assigned

H. Nelson, 30481; John R. Lastova, 33149; H. Warren Burnam, Jr. 29366; Thomas E. Byrne, 32205; Mary J. Wilson, 32955; J. Scott Davidson, 33489; Alan M. Kagen, 36178; Robert A. Molan, 29834; B. J. Sadoff, 36663; James D. Berquist, 34776; Updeep S. Gill, 37334; Michael J. Shea, 34725; Donald L. Jackson, 41090; Michelle N. Lester, 32331; Frank P. Presta, 19828; Joseph S. Presta, 35329; Joseph A. Rhoa, 37515.

I also authorize Nixon & Vanderhye to delete any attorney names/numbers no longer with the firm and to act and rely solely on instructions communicated from the person, attorney, firm or other organization sending instructions to Nixon & Vanderhye on behalf of the owner.

Certificate Under 37 C.F.R. §3.73(b)

I hereby certify that South Dakota School of Mines and Technology of 501 East Saint Joseph Street, Rapid City, South Dakota 57701-3995 is the assignee of the entire right, title and interest in the patent application identified above by virtue of an assignment from the inventors to the aforesaid assignee, a copy of the assignment being attached.

I have reviewed the documents in the chain of title of the patent application identified above, and to the best of my knowledge and belief, title is in the aforesaid assignee for which I am empowered to act in this matter.

I declare further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the

IYER

Serial No. To Be Assigned

like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title

18 of the United States Code and that such willful false statements may jeopardize the

validity of the application or any patent issuing thereon.

South Dakota School of Mines and
Technology7/15/00

Date

By:



Name:

Timothy G. Henderson

Title:

V.P. of Business & Administration